Incidence, Epidemiology, and Treatment of Aneurysmal Subarachnoid Hemorrhage in 12 Midwest Communities

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Only 8 studies have investigated the incidence and epidemiology of aneurysmal subarachnoid hemorrhage (aSAH) in the United States. This is the first investigation in Indiana, which has some of the highest rates of tobacco smoking and obesity in the nation. The authors prospectively identified 441 consecutive patients with aSAH from 2005 to 2010 at 2 hospitals where the majority of cases are treated. Incidence calculations were based on US Census populations. Epidemiologic variables included demography; risk factors; Hunt and Hess scale; Fisher grade; number, location, and size of aneurysms; treatment type; and complications. Overall incidence was 21.8 per 100,000 population. Incidence was higher in women, increased with age, and did not vary by race. One third to half of patients were hypertensive and/or smoked cigarettes at the time of ictus. Variations by count were partially explained by Health Factor and Morbidity Rankings. Complications varied by treatment. These findings deviate from estimates that 6-16 per 100,000 people in the United States will develop aSAH and are double the incidence in a Minnesota population between 1945 and 1974. The results also deviate from the worldwide estimate of 9.0 aSAHs per 100,000 person-years. The predictive value of variations in Health Factor and Morbidity Rankings implicates the importance of future research on multivariate biopsychosocial causation of aSAH. **Key Words:** Subarachnoid hemorrhage—intracranial aneurysm—brain aneurysm—epidemiology—Indiana.

Introduction

In the United States, 795,000 people experience stroke each year, and 610,000 of these are first-ever strokes.[1] Stroke is the fourth leading cause of death in the United States.[1] Subarachnoid hemorrhage (SAH), the most deadly and debilitating type of stroke, conservatively represents 3% of all strokes[1] or 18,300 cases of new strokes each year.

The etiology of spontaneous SAH includes ruptured cerebral aneurysms, arteriovenous malformations, and iatrogenic or idiopathic bleeding disorders. A ruptured intracranial aneurysm is the most common cause of nontraumatic SAH, accounting for 85% of all SAHs.[2] In contrast to nonaneurysmal SAH, aneurysmal SAH (aSAH) portends high rates of mortality and morbidity. Case fatality for aSAH ranges from 32% to 67%[3] of cases with one third of deaths occurring within 30 days of the event.[4] One third of survivors require lifelong care,[3] and

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psychosocial outcomes are poor even among patients who fare well neurologically and medically.[5-7]

Risk for SAH increases with age and is more prevalent among women, African Americans, and Hispanics. Risk factors include female sex, race, hypertension, hyperlipidemia, cigarette smoking, cocaine use, excessive alcohol consumption, family history of SAH, and some connective tissue disorders.[8-12]

The prevalence of unruptured or "silent" intracranial aneurysm has been estimated as 3.2% based on 94,912 patients from 21 countries with an average age of 50 years and equal proportions of women and men.[13] Rinkel et al[14] identified the prevalence of asymptomatic intracranial aneurysm among adults without risk factors ranging from .4% in retrospective autopsy studies to 6.0% in prospective angiography studies. The annual risk of rupture was .7% for small aneurysms (<10 mm) and 5.5% for larger aneurysms among adults without risk factors.[14] Among individuals with no history of SAH, the rates of rupture for aneurysms less than 10 mm, more than 10 mm, and more than 25 mm in diameter were .05%, less than 1%, and 6.0% per year, respectively, as reported by the International Study of Unruptured Intracranial Aneurysms Investigators.[15]

To date, at least 45 studies examining the incidence of SAH worldwide have been published.[4,16-60] All these studies focused on spontaneous (nontraumatic) SAH and most covered first-ever events, but they varied in case-inclusion criteria (aneurysmal only or in combination with arteriovenous malformations), case recruitment methods (hospital referrals, autopsy records, death certificates, etc.), patient ages, and catchment years (from 1945 to 2010).

Available estimates place the worldwide incidence of spontaneous (primarily aneurysmal) SAH from a low of .56 per 100,000 population in Mashad, Khorasan Province, Iran,[60] to 140.1 per 100,000 among Mexican Americans in Nueces County, TX.[24] Meta-analysis of 18 studies conducted between 1960 and 1994 calculated the overall incidence rate at 10.5 per 100,000 person-years.[61] An analysis adding 33 new studies through October 2005 to the original 18 identified the worldwide incidence of SAH as 9.0 per 100,000 person-years with emphasis on notably higher rates in Finland and Japan and relatively lower rates in Central and South America.[62]

To date, 8 reports estimating the incidence of SAH in the United States have been published (details are shown in Supplemental Table A).[22-24,27,42,49-51] These studies vary in clinical focus, patient ages, and catchment years, making direct comparison difficult. Incidence for Caucasian Americans ranges from 3.7 per 100,000 in Bernalillo County, New Mexico, to 87.0 per 100,000 in Nueces County, TX. Incidence for African Americans ranges from 3.2 per 100,000 women in Northern Manhattan to 34.3 among women in Southern Alabama. Hispanic incidence ranges from 6.3 per 100,000 men in Northern Manhattan to 140.1 per 100,000 in Nueces County, TX.

With the exception of a study in Greater Cincinnati/Northern Kentucky[22] and another in Rochester, MN,[49] aSAH has not been quantified in the heartland of the American Midwest. Our goal was to prospectively describe the incidence and epidemiology of aSAH in 12 Midwestern communities located in central Indiana.

Methods

We determined the incidence and epidemiology of aSAH among 441 consecutive patients (with 446 ruptured aneurysms) treated between January 1, 2005, and December 31, 2010. Patients in the study population were treated at either of the 2 tertiary care hospitals located in central Indiana: Methodist Hospital, Indianapolis, an 802-bed hospital with a level 1 trauma center, and St Vincent Hospital, Indianapolis, an 800-bed hospital with a level 2 trauma center. The study population included 313 women (71%) and 128 men (29%). The distribution of patient race was 80.9% (n = 355) Caucasian, 12.7% (n = 56) African American, 2.3% (n = 10) Asian, 1.8% (n = 8) Hispanic of unknown race, and 2.3% (n = 10) other.

All cases originated within 100 miles of 1 or both of the 2 hospitals in the 12 contiguous counties studied. In these counties, patients with SAH are nearly exclusively referred to the 2 hospitals in our study. The distribution of aSAH cases from each county is shown in Table 1. In 2010, the proportion of female residents and the median age in each county were similar to those for nonstudy Indiana counties,[63,64] the Midwest,[65,66] Indiana as a whole,[63,64] and the United States[65,66] (Table 1). The proportion of African American residents was smaller, and median income was higher in study counties compared with nonstudy counties, the state, the Midwest, and the nation (Table 1).

None of the ruptured aneurysms were identified incidental to an unrelated evaluation or on autopsy. One case potentially resulting from trauma was removed from the series for this analysis. Diagnostic confirmation of aSAH symptomology was made based on computed tomography (CT) or cerebral spinal fluid analysis through lumbar puncture. Assessment of aneurysms was performed using CT angiography, cerebral arteriogram, or occasionally magnetic resonance angiography for patients with compromised renal function. When multiple aneurysms were found, determination of the ruptured aneurysms was made by the attending neurosurgeon or interventional neuroradiologist based on imaging or intraoperative findings.

Data were recorded from the time of admission until hospital discharge or death. Study variables include patient sex, age, race, and county of origin; risk factors for SAH including family history of brain aneurysm, hypertension, diabetes, hyperlipidemia, and smoking; Hunt and Hess scale of SAH clinical severity on hospital admission[67]; Fisher grade of SAH appearance on CT scan evaluation[68]; number of ruptured and unruptured